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(54) **RATCHET WRENCH INTERFACE SYSTEM**

(71) Applicant: **Brent Louis Hock**, Mansfield, TX (US)

(72) Inventor: **Brent Louis Hock**, Mansfield, TX (US)

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B25B 13/46 (2006.01)
B25B 13/50 (2006.01)

(52) **U.S. Cl.**
CPC ***B25B 13/12*** (2013.01); ***B25B 13/462*** (2013.01); ***B25B 13/5058*** (2013.01)

(58) **Field of Classification Search**
CPC B25B 13/462
USPC 81/58.2
See application file for complete search history.

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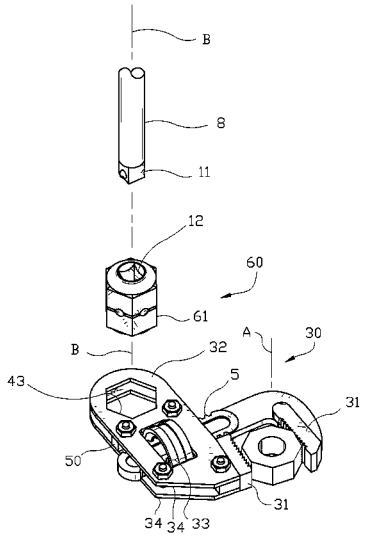
Primary Examiner — Hadi Shakeri
(74) *Attorney, Agent, or Firm* — Guy V. Manning, Esq.

(57) **ABSTRACT**

A right-angle socket for ratchet tools includes a hexagonal drive port adapted to receive interchangeable interface fittings, or adapters, which accept ratchet drives from various styles of ratchets. The interface fitting journals within and coaxial with the hexagonal drive port and is held in place by a keeper such as a spring ball. A coaxial port within the interface fitting accepts one type of conventional ratchet drive, such as a square drive, of selected size commonly available. Other interface fittings accept other types of ratchet drives, such as pass-through drives. The interface fitting may be inserted from either side of the socket and includes a circumferential groove that receives the keeper to hold the interface fitting axially affixed within the hexagonal port. Both single and double-sided interface fittings are provided, as well as swivel fittings.

12 Claims, 7 Drawing Sheets



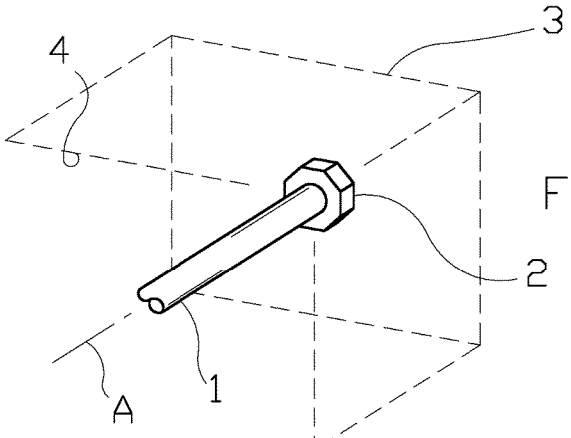


Fig. 1A
PRIOR ART

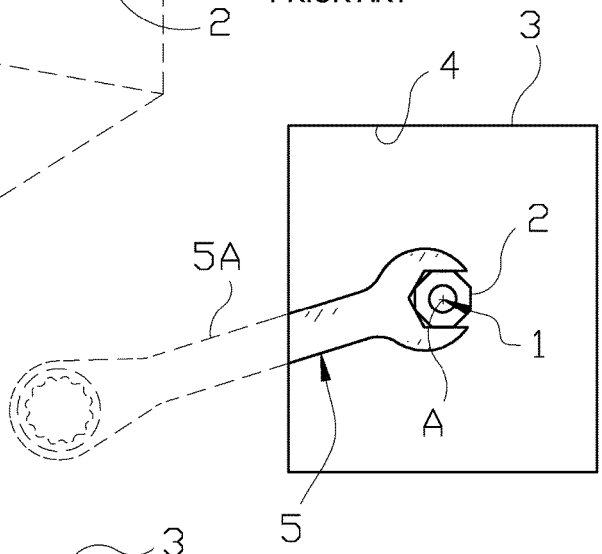


Fig. 1B
PRIOR ART

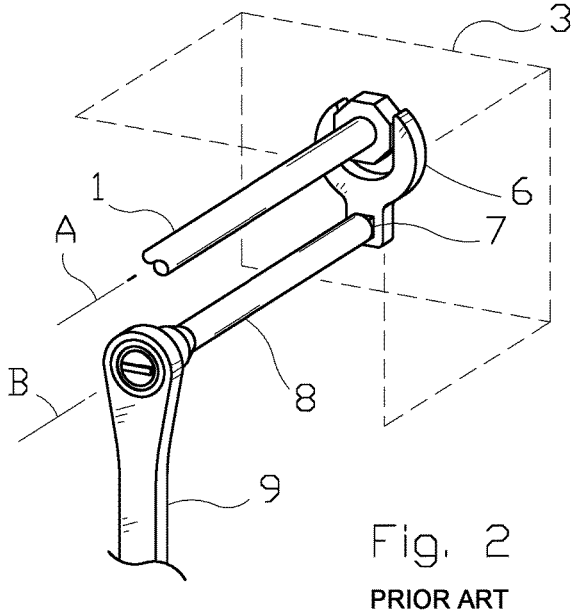


Fig. 2
PRIOR ART

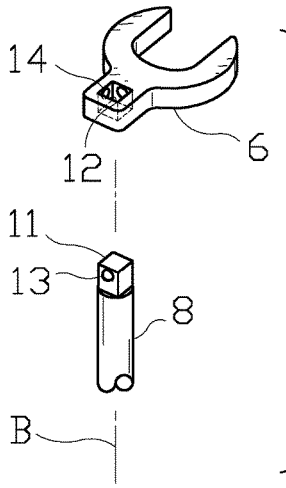


Fig. 3
PRIOR ART

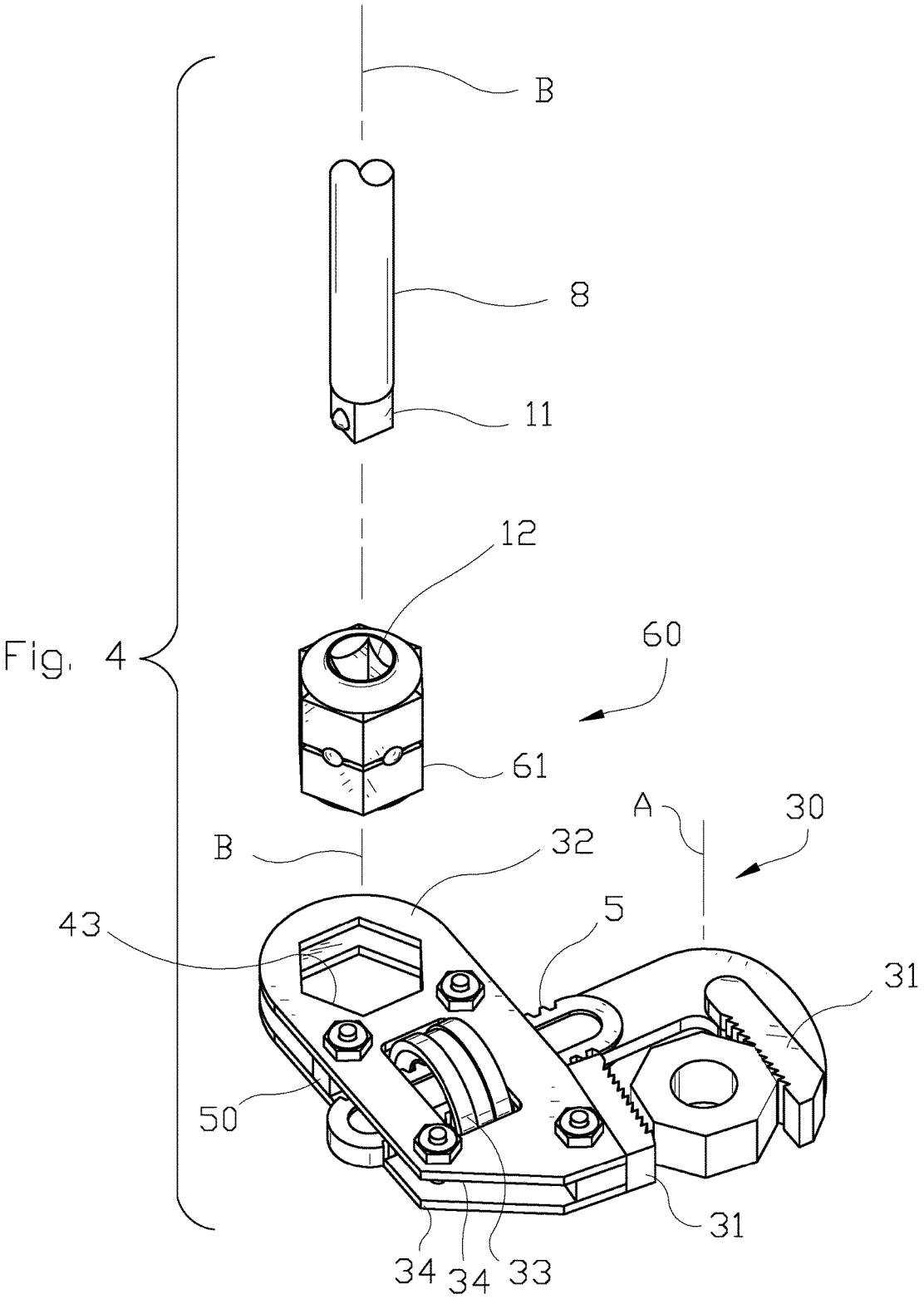


Fig. 4

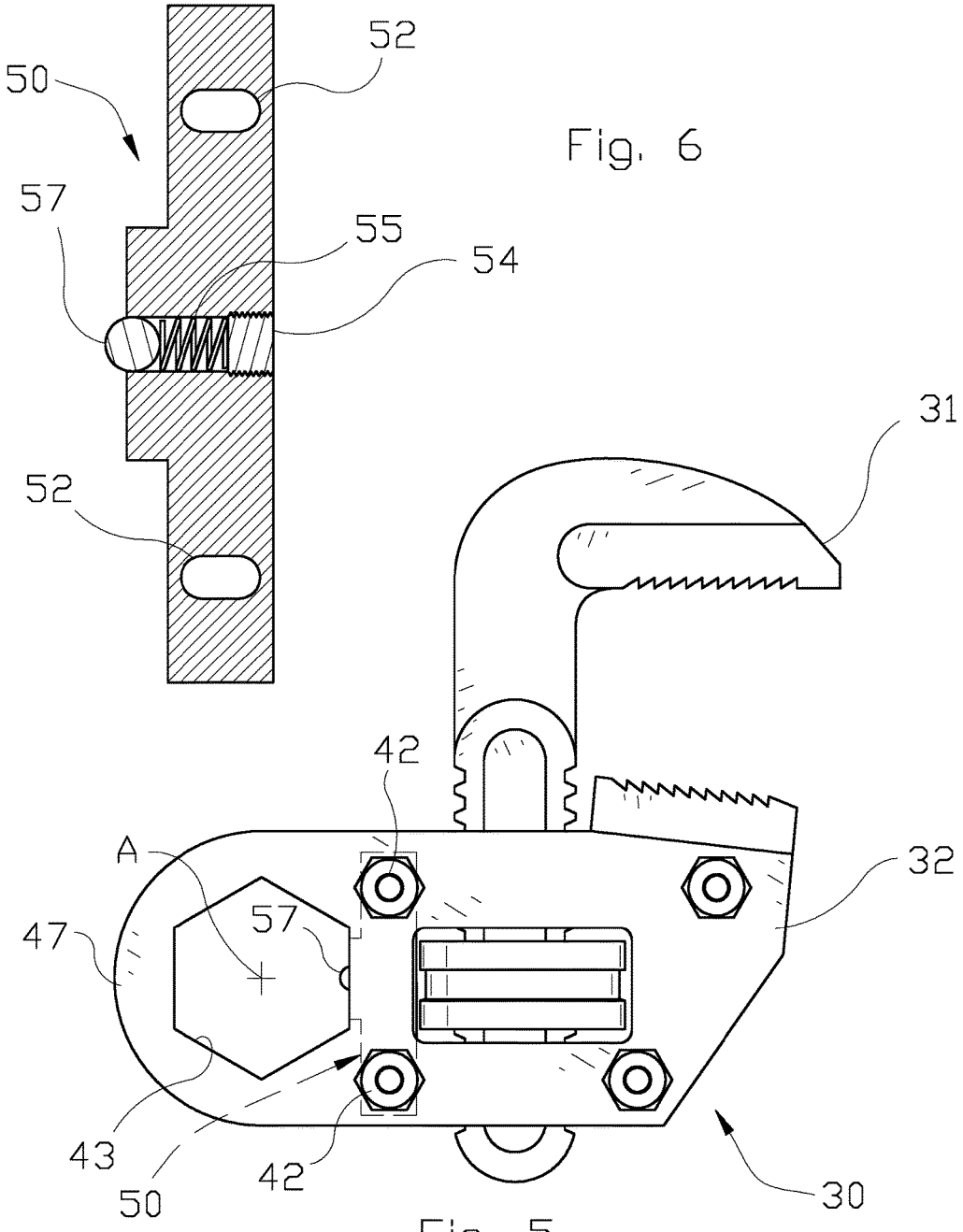


Fig. 6

Fig. 5

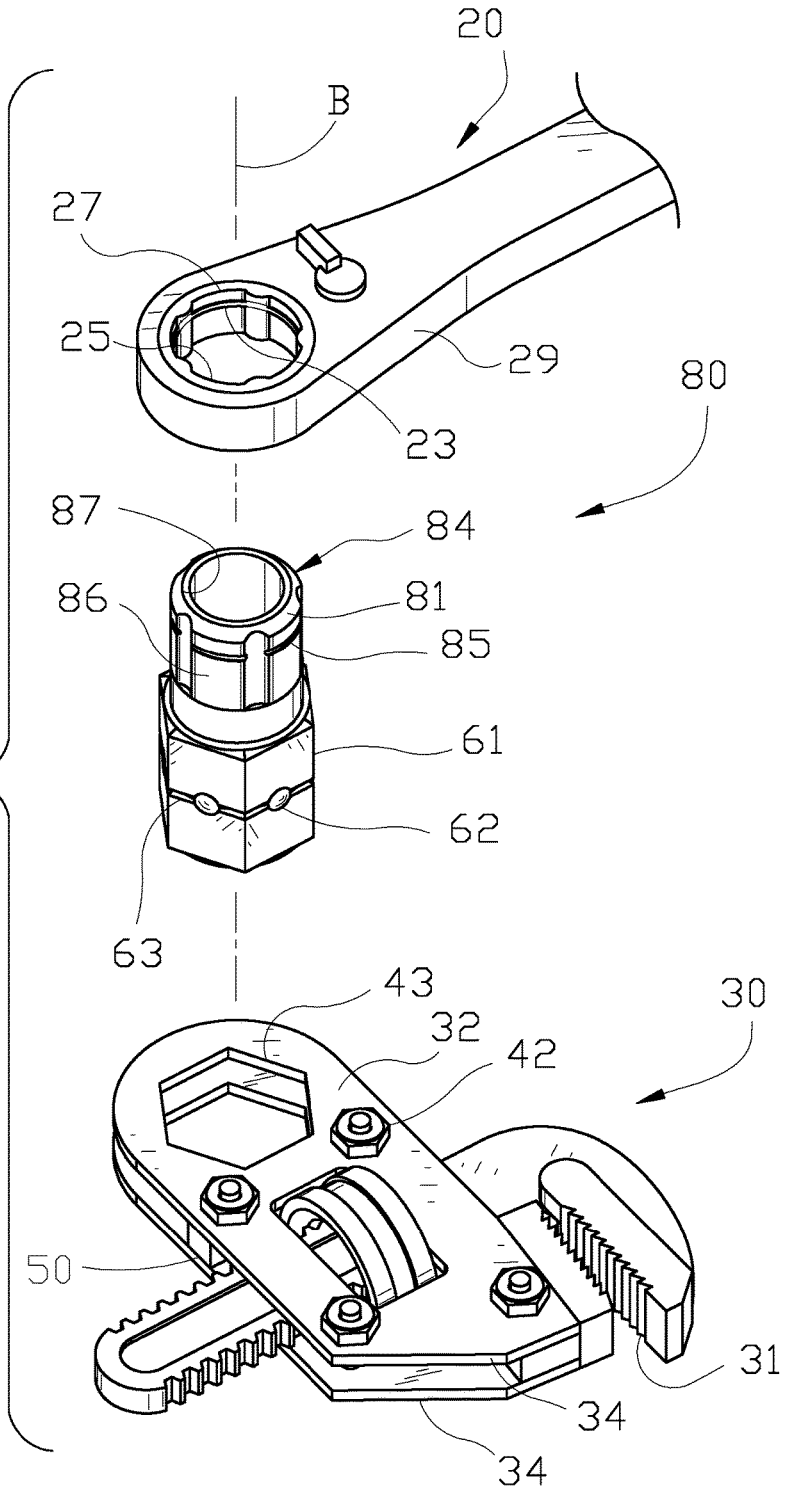


Fig. 7

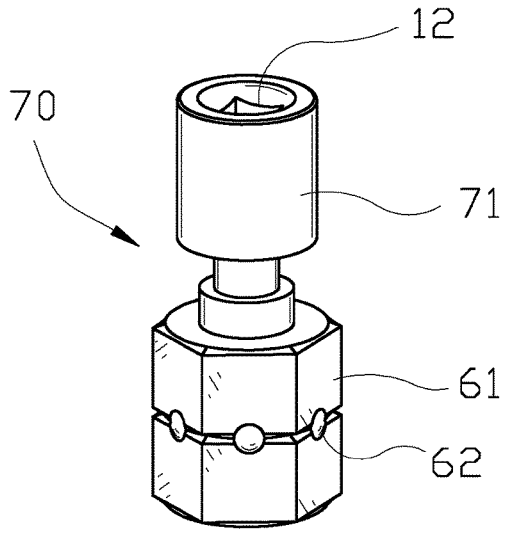


Fig. 8A

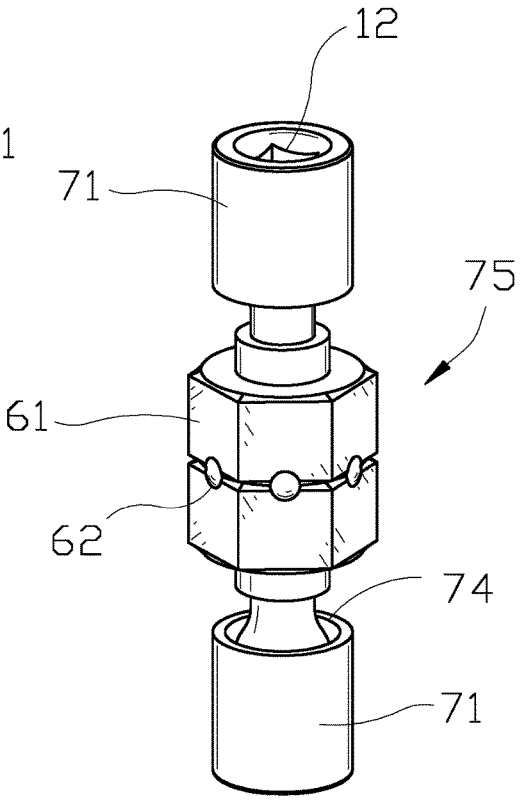


Fig. 8B

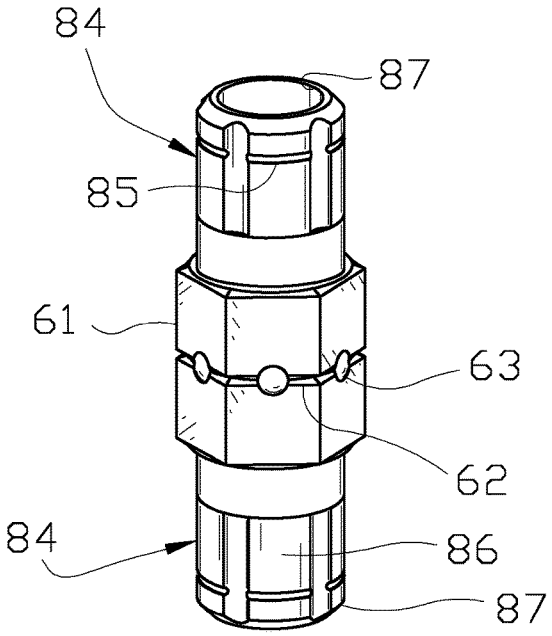


Fig. 8C

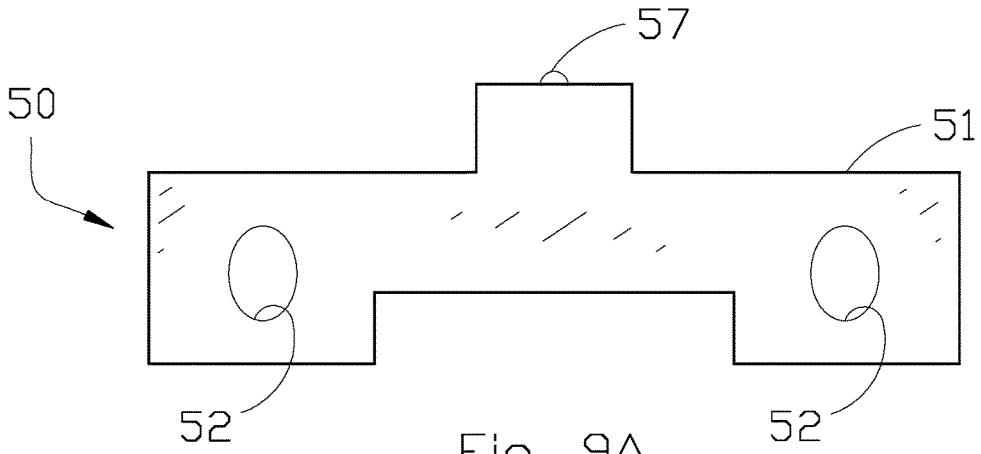


Fig. 9A

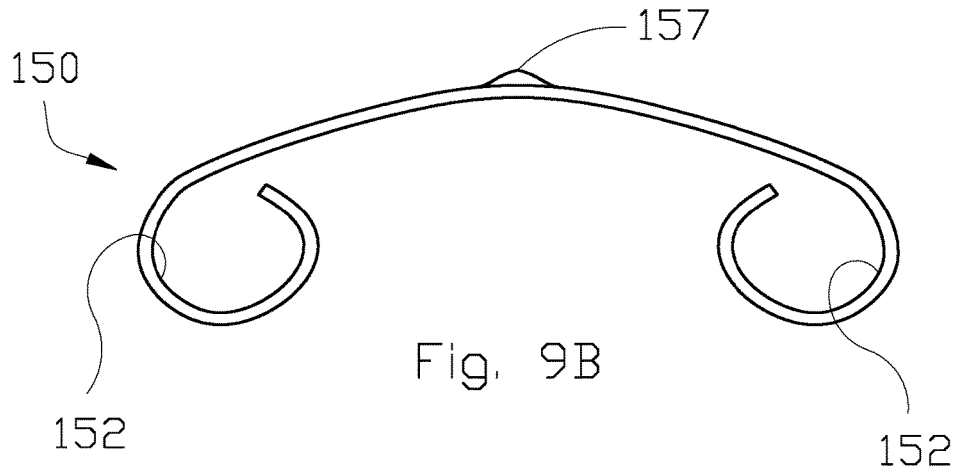


Fig. 9B

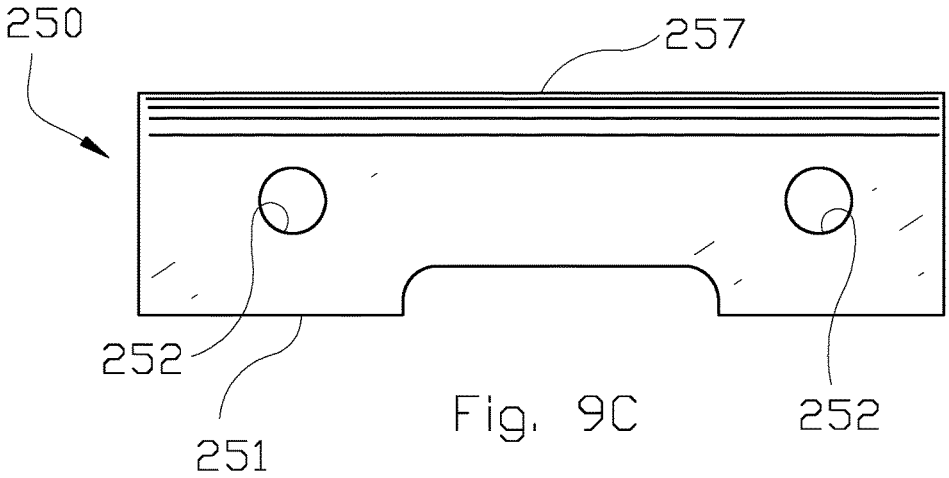


Fig. 9C

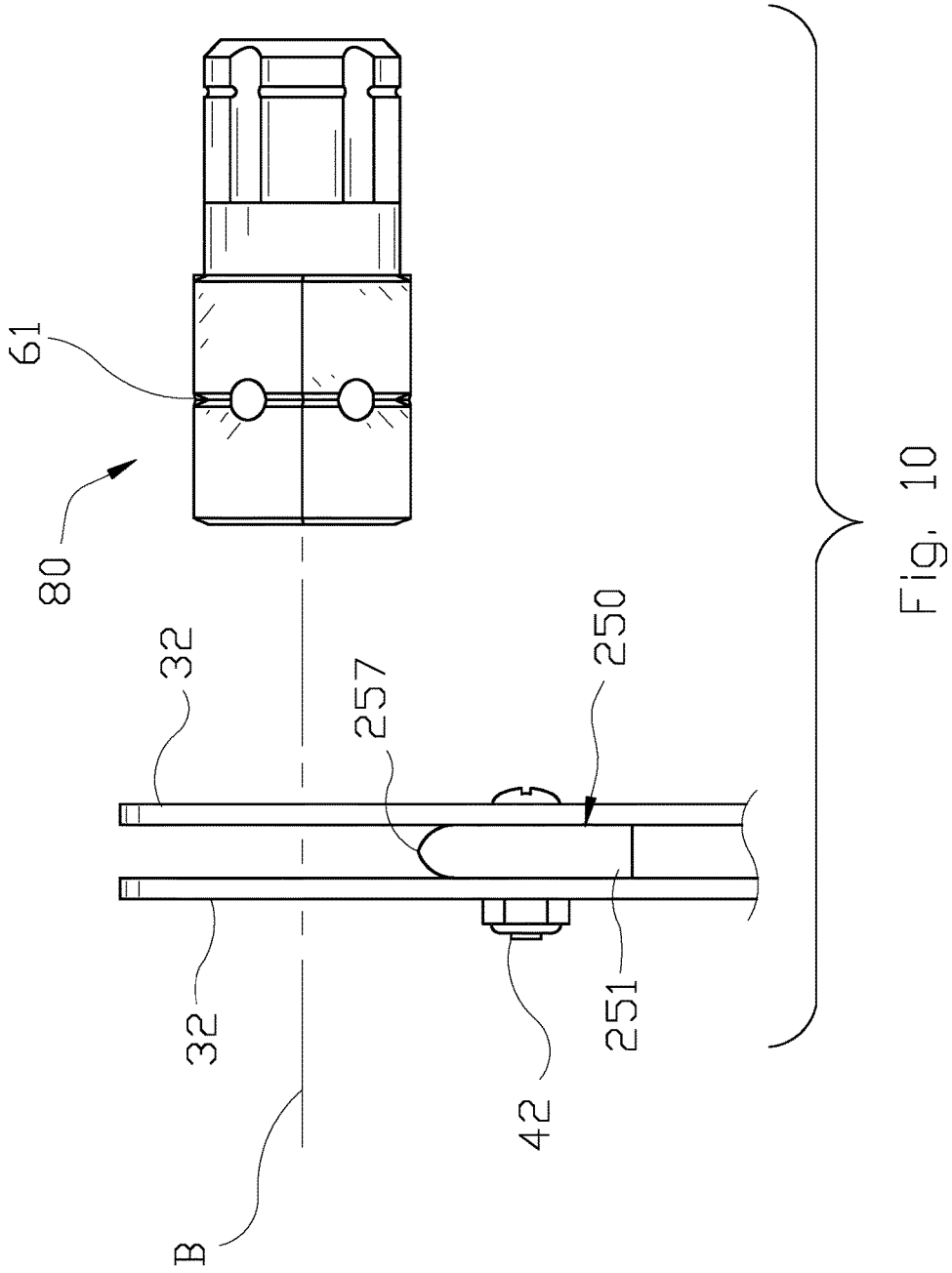


Fig. 10

RATCHET WRENCH INTERFACE SYSTEM

This application claims priority from U.S. Provisional Patent Application Ser. No. 62/144,595, filed Apr. 8, 2015.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to hand tools and particularly to ratchet and socket style wrench systems having fittings for right-angled access. More particularly, this invention relates to an interchangeable system for coupling right-angled wrench fittings to multiple styles of ratchets.

2. Description of Related Art

Manual wrenches comprise elongate handles on the ends of which are disposed workpiece-engaging means such as a box-end or open-end jaw adapted to fit the typically parallel sides of a hexagonal nut. The jaw engages the nut and the user rotates the handle substantially coplanar with the nut through an angular portion of a circle to tighten or loosen the nut relative to the workpiece (typically a bolt). The user then disengages the jaw and shifts the handle back through the same arc, then re-engages the jaw with the nut for another turn. A plurality of such steps usually tightens or loosens the nut sufficiently to achieve the user's purpose, including removing the nut altogether if that is the user's aim. A more recent variation on this type of wrench includes a ratchet mechanism within a box-end wrench which provides more convenient resetting of the wrench handle position for repeated turns without having to remove from and re-engage the box end onto the nut.

In some situations, manual wrenches won't work, such as where there is insufficient space surrounding and coplanar with the nut to rotate the manual wrench handle. See, e.g., FIG. **1**A. Some manual wrenches also include hinged handles which allow some accommodation of tight space constraints, but hinged manual wrenches don't allow as much torque to be applied in their offset handle position as can be applied when the handle is coplanar with the workpiece.

Ratchet wrench systems provide an alternative to manual wrenches whereby a socket fitting coaxially surrounds the nut and includes a port extending above the nut into which a drive fits for turning the socket. A ratchet handle engages the socket and applies torque to the nut through the socket. The ratchet handle thus is offset from the plane of the nut, thereby possibly also overcoming the tight, handle-rotating space problem described above. If needed, the ratchet may couple to the socket by an elongate extension which allows the ratchet handle to be offset considerably more from the socket. This enables a user to reach into tight places to address a workpiece inaccessible with a convention, coplanar wrench. See generally FIGS. **1**A-**3**.

In some situations, however, sockets adapted to surround the nut cannot be used, largely because the workpiece on which the nut is mounted is too long to be enclosed by the socket, or the axial top of the nut cannot be reached because of obstructions. In such cases, offset tools have developed which allow use of an open-end jaw having a drive port. Called "crows feet", such tools comprise means for accessing a nut which otherwise could not be reached by either ratchet or manual wrenches. See FIGS. **2**, **3**.

Ratchet wrench drive systems are commonplace but usually incompatible with each other. The most common

square-drive ratchet wrench system comprises a ratchet handle bearing a short, square post which mates with compatibly sized square ports within multiple sockets for use with varied bolt and nut sizes. The system works well for most situations, but not well for nuts turned down onto elongated bolts which extend through the nut too far for the socket to enclose. Deep square-drive sockets are available but limited in their depth and consequently the length of bolt they can accommodate. The conventional solution requires using box-end or open-end wrenches that allow the bolt to pass through the tool, but suffer from the above described problem of coplanar accessibility.

Pass-through ratchet systems developed to address such applications. Pass through drives and sockets, however, seldom are compatible with square post sockets and vice versa. This leads to the need to acquire, store, inventory and select from myriad ratchet wrench systems for various applications. A need exists for a single set of tools which accepts different ratchet wrench systems.

Some types of tools traditionally are not configured for use with ratchet wrench systems. For example, pipe wrenches with expandable jaws for gripping round surfaces such as steel pipe typically rely upon fixed handles coplanar with the gripping jaws. Swivel-headed wrenches having their jaws hinged to an elongate handle provide flexibility for tight applications but limit the torque that can be applied in all but coplanar positions. A need exists for such traditionally unratcheted tools capable of being used with ratchets and for a single tool system that works with multiple ratchet systems.

SUMMARY OF THE INVENTION

A right-angle socket for ratchet tools includes a hexagonal drive port adapted to receive interchangeable interface fittings, or adapters, which accept ratchet drives from various styles of ratchets. The interface fitting journals within and coaxial with the hexagonal drive port and is held in place by a keeper such as a spring ball. A coaxial port within the interface fitting accepts one type of conventional ratchet drive, such as a square drive, of selected size commonly available. Other interface fittings accept other types of ratchet drives, such as pass-through drives. The interface fitting may be inserted from either side of the socket and includes a circumferential groove that receives the keeper to hold the interface fitting axially affixed within the hexagonal port. Both single and double-sided interface fittings are provided, as well as swivel fittings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the present invention is set forth in appended claims. The invention itself, as well as a preferred mode of use and further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIGS. **1**A-**1**B show a workpiece problem ensconced within tight quarters in which a conventional wrench may not function efficiently or at all.

FIG. **2** illustrates how the problem of FIGS. **1**A-**1**B commonly is solved using a square-drive ratchet on an offset tool to address the workpiece.

FIG. **3** details the square-drive system shown in FIG. **2**.

FIG. **4** shows the universal tool interface system of the present invention.

FIG. **5** shows a right side elevational view of a particular workpiece tool adapted for use with the present invention.

FIG. **6** details a keeper for the workpiece tool of FIG. **5**.

FIG. **7** shows another style of ratchet drive in use with the present invention.

FIGS. **8**A-**8**C illustrate various workpiece tool interface fittings of the present invention.

FIGS. **9**A-**9**C show alternate embodiments for the keeper of FIG. **6**.

FIG. **10** details the rubber keeper of FIG. **9**C in context.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the figures, and particularly to FIGS. **1**A-**2**, workpiece **1** is shown extending into recess **4** of cabinet **3** and bearing hexagonal nut or coupling **2**. A user (not shown) will have difficulty reaching into recess **4** with a conventional wrench **5**. Specifically, handle **5**A of wrench **5** is too long to operate within the confines of recess **4**.

The typical solution appears in FIG. **2** side-drive socket **6**, or "crows foot" socket is placed within recess **4** in engagement with nut **2** and accessed remotely using ratchet **9** coupled to socket **6** by extension **8**. Turning the handle of ratchet **9** in a plane parallel to the plane of socket **6** and nut **2** applies the required torque to nut **2** from without recess **4**.

Ratchet **9** also may be equipped with direct-sockets (not shown) sized to nut **2** and which surround axially nut **2** when workpiece **1** is short enough (not shown), such as where nut **2** is threaded onto the end of a bolt (not shown). A plurality of such coaxial sockets typically comes in a set for various sizes of nut **2**. Further, a deep-socket version of such coaxial sockets (not shown) accommodates some protrusion of workpiece **1** beyond nut **2** and coaxially into such deep coaxial sockets, thereby enabling tightening and loosening nut **2** even though it is not right at the end of workpiece **1**. As depicted in the figures, however, workpiece **1** may comprise a pipe or other elongate object bearing nut **2** such that conventional, coaxial sockets (not shown) for square drive ratchet **9** are too shallow to work. The only way to turn nut **2** in such situations is from side access using a side-access tool such as crows foot socket **6**.

As best seen in FIG. **3**, side-access socket **6** is equipped with a conventional, square port **12** into which fits square-drive nose **11** of either ratchet **9** or extension **8**. Spring loaded ball **13** embedded in one side of nose **11** snaps into one of corresponding dished-out recesses **14** within the side walls of port **12** to removably retain nose **11** therein, or, alternately, to retain socket **6** on nose **11**, while socket **6** is maneuvered into place and while torque is applied to nut **2**.

Turning now also to FIGS. **4**-**6**, an alternative to crows foot **6** comprises pipe-wrench type tool **30** adapted for side access to objects in the tightly constrained access situation described above. Tool **30** could be used to address either nut **2** (FIG. **4**), or applied directly onto workpiece **1** (not shown). One having ordinary skill in the art will recognize that a variety of tools **30**, in addition to those shown in the figures, could be employed in this situation, and that all such alternative tools **30** are considered to be within the spirit and scope of the present invention.

The interface system of the present invention further includes interface fitting, or adapter **60** having hexagonal torso **61** adapted to be received within corresponding hexagonal adapter port **43** within tool **30**. In the embodiment shown in the figures, tool **30** comprises a pipe wrench having no extended handle **5** (see FIG. **1**B) but instead adapted to apply torque to workpiece **1** using a ratchet and extension similarly to that shown in FIG. **2**. Tool **30** includes jaws **31** coupled to body **32** which extends rearward from jaws **31** a spaced distance. Bolts **42** clamp the two sides of body **32** together such that tool **30** comprises a rigid body which may be rotated about axis A to apply torque to nut **2**. Hexagonal aperture **43** extends normal to and through the thickness of body **32** and coaxial with axis B.

Torso **61** is adapted to be received within port **43** such that detent groove **62** aligns with keeper **50** in tool **30**, thereby spanning between plates so that torque applied to square nose **11** using square drive ratchet **9** is applied to both sides of jaws **31**. Extension **8** is shown coaxial with axis B and extending upwards to couple to ratchet **9** (not shown) which then may be employed to apply rotational force to tool **30** and thereby to nut **2**.

Keeper **50** comprises spring ball held in place by keeper body **51** slidably affixed between plates of tool **30** by bolts **42** which also hold plates together. Keeper **50** doubles as a spacer between plates adjacent port **43**. Keeper body **51** bears slotted bolt holes **52** adapted to receive bolts **42**, allowing for minor adjustment of keeper **50**'s position relative to port **43**, for adjusting tightness between torso **61** and tool **30**. Spring ball is positioned at one end of channel transverse to keeper body **51** and held in place by set screw **54**. Biasing spring **55** urges ball against the opposite end of channel so that it compressibly engages detent groove **62** when torso **61** is inserted within port **43**, thereby removably affixing tool **30** to spine system drive adapter **60** and ratchet.

Turning now also to FIGS. **9**A-**10**, alternate embodiments to keeper **50** comprise spring steel keeper **150** and rubber keeper **250**. Spring steel keeper **150** comprises a length of resilient spring steel bent into a shallow, obtuse angle at its midpoint and coiled at either end to form channels **152** which surround bolts **42** similarly to bolt channels **52** of keeper **50**. Also similarly, channels **152** only loosely surround bolts **42**, permitting adjustment of the position of keeper **150** similarly to that of keeper **50** as described above. Atop the midpoint of keeper **150** and positioned on the opposite side of keeper **150** from channels **152**, nib **157** takes the place of spring ball **57** to engage detent groove **62** of adapter **60**.

As depicted in FIGS. **9**C, **10**, keeper **250** comprises a rectangular slab body **251** of uniform thickness adapted to fill the space between plates. Keeper **250** is held in place by bolts **42** passing through apertures **252**, which may be slotted (not shown) for adjustment purposes, as discussed above for channels **52**, **152**. Keeper body **250** further includes ridge **257** extending along its longitudinal length parallel to plates. Ridge **257** engages detent groove **62** of adapter **60** to retain adapter **60** within aperture **43**. Preferably, keeper body **250** is made of an erosion-resistant rubber, but one having ordinary skill in the art will recognize that it could comprise harder materials such as aluminum, hard lead and even steel without departing from the spirit and scope of the present invention.

Turning now also to FIG. **7**, an alternate embodiment of the present invention is shown. As mentioned above, some workpieces **1**, comprise elongated, threaded bolts which extend beyond the depth of typical deep-sockets. Accordingly, pass-through systems employing pass-through sockets and wrenches (neither shown) developed to enable use of ratchets coaxially surrounding such workpieces **1** instead of requiring side-socket **6**.

One such pass through system employs spline drive ratchets **29** adapted to mate with splines arrayed around tubular nose **81** extending from conventional nut-drive sockets (not shown). Spines mate with corresponding spline

grooves **25** disposed within the perimeter of annular port **27** in pass-through ratchet **29**. Such systems enable engaging nut **2** coaxially by allowing workpiece **1** to extend through ratchet **29** along axis B. Annular spring **23** recessed within ratchet **29** mates with corresponding annular groove **85** on nose **81** to retain the sockets within ratchet **29** in similar fashion to keeper **50** discussed above.

Spline-drive adapter **80** is similarly adapted to be received within adapter port **43**. In lieu of aperture **12**, spline drive system adapter **80** includes nose **81** coupled to torso **61** and extending upward coaxial with axis B to couple to ratchet **29** of spline-drive system **20**. One having ordinary skill in the art will recognize that a spline-drive extension (not shown) could interface between nose **81** and ratchet **29** to reach far enough into recess **4** of cabinet **3** (FIG. **1**A). As in FIG. **4**, torso **61** is adapted to be received within port **43** and retained there by keeper **50**, **150**, **250**.

One having ordinary skill in the art will recognize that the spline-drive system depicted in FIG. **7** is incompatible with the square-drive system depicted in FIGS. **2-5** and that the fittings for each are not interchangeable. One having ordinary skill in the art also will recognize that other systems, such as a pass-through ratchet system called "O-Ratchet" and available from Summit Tools, Inc., of Burnaby, British Columbia, Canada, employ yet other fittings which are compatible neither with the square drive system of FIGS. **2-3** nor the spline drive system of FIG. **7**. One having ordinary skill in the art further will recognize that such other drive systems maybe employed to drive tool **30** by substitution of an adapter (not shown) analogous to adapters **60** but configured to mate with said other drive system. One having ordinary skill in the art further will recognize that all such drive system adapters are considered to be within the spirit and scope of the present invention.

Turning now to FIGS. **8**A-**8**C, a plurality of single and double-ended adapters are depicted. FIG. **8**A depicts and adapter for mating with a square drive, similar to adapter **60** depicted in FIG. **4** but including a swivel joint interface between such square drive and adapter interface **60**. FIG. **8**B depicts a double-sided version of the adapter shown in FIG. **8**A. FIG. **8**C shows a double-sided version of the interface adapter **80** depicted in FIG. **7**. One having ordinary skill in the art will recognize that the present invention contemplates all such variations in interface adapters.

In operation, a user (not shown) desiring to utilize a ratchet drive set (not shown) in his possession first selects appropriate tool **30** for use with workpiece **1**. He then selects one of adapters **60**, **80** adapted to work with his ratchet drive set. He then inserts adapter **60**, **80** into port **43** so that his particular ratchet drive set can apply torque to tool **30**. The user then proceeds to perform his project as desired. In such fashion, one set of tools **30** can be employed for use with myriad ratchet sets as long as the user has an adapter **60**, **80** for his selected ratchet drive set.

While the invention has been particularly shown and described with reference to preferred and alternate embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention. For example, the invention described above works with ratchets **9**, **29** to apply torque to tools **30**, but drive handles adapted to interface with adapters **60**, **80** need not necessarily be ratcheted drives, but could be simple drive handles (not shown). Further, other types of tools **30**, such as a crescent wrench style jaws (not shown) could be employed with similar facility and utility. Still further, a hand-held tool (not shown) similar to a screwdriver handle could be configured to accept interface adapters **60**, **80**, enabling use of the drive sets similarly to the use of conventional nut drivers (not shown). Finally, torso **61** of adapters **60**, **80** has been discussed above as having a hexagonal cross section surrounding axis B, but it could include any shape having at least one torque engaging surface adapted to prevent rotation of torso **61** within aperture **43**, which would be shaped to snugly receive torso **61**. Torso **61**, e.g., could be square, octagonal, or round and including a key slot (none shown) adapted to mate with a corresponding key slot within plates.

I claim:

1. A ratchet wrench tool interface system comprising

a tool adapted to engage a workpiece, the tool having workpiece engaging jaws;

a substantially planar body containing the workpiece engaging jaws and surrounding and defining an interface port, the interface port having an axis normal to said planar body;

an interface torso adapted to be received coaxially within the access port and having a detent groove borne within an outer surface of and surrounding the torso;

a ratchet engaging interface disposed coaxial with the interface torso; and

a keeper disposed within the planar body adjacent the interface port, the keeper adapted to engage the detent groove within the interface torso and retaining the interface torso within the aperture, the keeper further having,

a substantially rectangular block slidably disposed between two plates coupled to the tool, the block held between said two plates by bolts extending through slotted apertures within the block, the block bearing a detent groove engaging means on a proximal side of said block adjacent said interface access port for engaging said detent groove in said torso.

2. The ratchet wrench tool interface system of claim **1** wherein

the torso body surrounds and defines a cylindrical aperture extending through the torso body and adapted to journal with the workpiece; and

the ratchet engaging interface includes at least one spline nose extending coaxially from said torso body and surrounding said cylindrical aperture, the spline nose bearing a plurality of splines disposed on the outside of the spline nose and substantially parallel the axis, the spline nose and splines adapted to engage a ratchet.

3. The ratchet wrench tool interface system of claim **1** wherein the detent groove engaging means comprises

a duct disposed through the block normal to the interface access port, said duct bearing a ball bearing biased toward said interface access port by a spring, said ball bearing adapted to engage the detent groove.

4. The ratchet wrench tool interface system of claim **1** wherein the detent groove engaging means comprises

a ridge disposed along a proximate side of said rectangular block parallel said two plates, said ridge extending toward and adapted to engage said detent groove.

5. The ratchet wrench tool interface system of claim **4** wherein

the rectangular block is made from abrasion-resistant rubber.

6. The ratchet wrench tool interface system of claim **1** wherein said keeper means comprises

a spring steel body extending between two bolts extending parallel said axis through two plates coupled to the tool planar body, the spring steel body bearing a nib

disposed adjacent and extending into the interface access port and adapted to engage the detent groove.

7. A ratchet wrench tool interface system adapted to interface with a ratchet wrench, the ratchet wrench having a ratchet wrench drive system, the ratchet wrench tool interface system comprising

a tool adapted to engage a workpiece, the tool having

workpiece engaging jaws adapted to grasp a workpiece and enable a user to rotate said workpiece;

a substantially planar body containing the workpiece engaging jaws and surrounding and defining an interface access port, the interface port having an axis normal to said planar body;

an interface torso adapted to be received coaxially within the interface access port and having a detent groove borne within an outer surface of and surrounding the torso;

ratchet engaging means disposed coaxial with the interface torso for mating with said ratchet wrench drive system; and

a keeper disposed within the planar body adjacent the interface port and adapted to retain the interface torso within the aperture, the keeper having

a keeper body disposed between two parallel plates coupled to the planar body;

at least two bolts journaled through said parallel plates parallel to said axis and extending through slotted apertures within said keeper body; and

spring detent engagement means disposed within said keeper body adjacent said interface access port for springily engaging said detent groove.

8. The ratchet wrench tool interface system of claim **7** wherein said spring detent engagement means comprises

a ball spring disposed within a duct extending through said keeper body normal to said axis and biased toward said interface access port by a spring.

9. The ratchet wrench tool interface system of claim **7** wherein said spring detent engagement means comprises

a nib born on a proximate surface of said keeper body, said keeper body being fabricated from spring steel adapted to bias said nib toward said detent groove.

10. The ratchet wrench tool interface system of claim **7** wherein said spring detent engagement means comprises

a resilient ridge disposed along a proximate surface of said keeper body adjacent said interface access port, said resilient ridge extending into said interface access port toward said axis and adapted to removably engage said detent groove.

11. An improved method of applying a ratchet wrench to a workpiece, the method comprising

providing a plurality of tools adapted to fit a plurality of workpieces, each tool having

a workpiece engagement jaws and a tool body having two plates coupled to the workpiece engagement jaws, said two plates surrounding and defining an interface access port having an axis; and

a keeper disposed between said two plates and having a substantially rectangular block slidably held between said two plates by bolts extending through slotted apertures within the block, said keeper bearing a detent engaging means disposed adjacent said interface access port for engaging a detent;

providing a ratchet drive system having

a handle adapted to apply torque to said workpiece by rotating around said axis;

a ratchet drive extending coaxial with said axis and adapted to couple one at a time to each of the said plurality of tools;

providing an interface torso having a detent adapted to be removably received within said interface access port coaxial with said axis and with said detent engaged with said detent engaging means, said interface torso bearing ratchet drive engaging means extending coaxially from said interface torso to couple to said ratchet drive;

then

selecting a select one of said plurality of tools to fit said workpiece; then

journaling said interface torso within said interface access port within said select one of said tools; then

engaging said ratchet drive engaging means with said ratchet drive; then

operating said handle to apply torque to said workpiece.

12. A ratchet wrench tool interface system comprising

a tool adapted to engage a workpiece, the tool having

workpiece engaging jaws;

a substantially planar body having two plates coupled to the workpiece engaging jaws, said two plates surrounding and defining an interface port having an axis normal to said planar body;

an interface torso removably and coaxially journaled within the interface port and having

a detent groove borne within an outer surface of the interface torso; and

a ratchet engaging interface disposed coaxial with the interface torso; and

a keeper disposed between said two plates and having

a substantially rectangular block slidably held between said two plates by bolts extending through slotted apertures within the block; and

detent groove engaging means on a proximal side of said block adjacent said interface port for engaging said detent groove in said interface torso.

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